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ABSTRACT

Two studies were conducted to find correlates of personality or cognitive style that were exemplified in differences in recall of semantic information from text. In both studies the texts were analyzed for the pattern of subordination, or hierarchy, of the semantic information that was contained in the passages using a method described by Meyer. In the first experiment, bilateral electroencephalograph measurements of alpha rhythm activity were taken from 40 univeristy students during a baseline period, during the reading period, and during the recall period: and they were classified as analytic (low alpha activity) or holistic (high alpha activity). It was found that when the text had little semantic organization there was no difference in the recall of the two groups, but when the text was more organized the analytic students recalled proportionately more superordinate material rather than subordinate material. In the second experiment, schizophrenics were compared with college students and with other hospitalized mental patients in a similar recall experiment. It was found that schizophrenics recalled very little of material from lists of elements that were related in an unspecified manner. (CTM)

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INDIVIDUAL DIFFERENCES IN SEMANTIC RECALL FROM TEXT

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INDIVIDUAL DIFFERENCES IN SEMANTIC RECALL FROM TEXT

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For the past several years, my colleagues and I have been investigating the relationships between various personality and cognitive styles and recall of semantic information from text. At first, because of our training as traditional learning psychologists, we were quite surprised by our data which consistently has shown that people who differ on several selected style or personality constructs, differentially recall explicit and implicit information from text. Given this consistency we no longer avoid or ignore these differences by making them part of our statistical error terms.

We have also been struck, as have others (e.g., Spiro & Tirre, 1979), by the fact that most of the psychological and even much of the educational literature concerning the comprehension and memory of linguistic stimuli, has scrupulously avoided the study of, and sometimes even the mention of, individual differences as possible systematic sources of variation in their data. This is quite surprising given the wealth of research literature showing that people having different personality or cognitive styles like Field Independence/Dependence (see Goodenough, 1976 for a review), Extraversion/Introversion (Eysenck, 1977) and Analytic/Holistic processors (Dunn, in press), frequently do not behave in the manner that various universal models of learning and memory, especially long-term memory, would predict.

For example, when field-independent subjects are given word lists containing categories but with the words presented in quasi-ramdom order (where field independence is a cognitive style related to the ability of overcoming embedded contexts by analyzing and structuring experience in new ways), they

tend to recall the word lists into the categories inherent in the list. On the other hand, field-dependent subjects (those who supposedly have difficulty overcoming embedded contexts) show little categorization at recall. Both cognitive styles, however, recall the same number of words (Meshorer, 1969). This is in sharp contrast to the predictions of several models of long-term memory (e.g., Mandler, 1967; Tulving, 1968) which state that the amount of categorical or subjective organization subjects impose on the material directly effects the number of items they recall. Therefore, field-dependent subjects should have recalled fewer words than field-independent subjects because they showed little clustering at recall.

In an important study using more complex stimulus material (i.e., narrative text) Rand Spiro and his colleagues (Spiro, Note 1; Spiro & Tirre, 1979) have found evidence suggesting that when reading and recalling narrative text students who score low on the embedded figures test (field-dependent subjects) do not use their prior knowledge schema to the same degree as do subjects with high embedded figure scores (field independent). Sprio has also speculated that field-dependent students may perform better if they utilize the author's organization during comprehension, while those who are more field-independent may perform better when using their own knowledge schema.

Clearly, the relation between organismic variables (such as those just cited) and text processing warrants further investigation, given the regularity of some of the research findings based on simple verbal materials (see Eysenck, 1977 - chapters 8-12 for a review). Fortunately, there is a growing body of research and interest concerning the relationships between individual differences, such as reading ability (Dunn, Mathews & Bieger, 1979; Meyer, Brandt, & Bluth, Note 2; Smiley, Oakley, Worthen, Campione, & Brown, 1977)

age (e.g., Meyer, Rice, Knight, & Jessen, 1979) and the comprehension and recall of extended text.

Unfortunately only a handful of studies has investigated cognitive style and personality differences as they relate to discourse processing (e.g., Wolk & Ducette, 1974), and even fewer of these have utilized the powerful semantic analysis procedures and text grammars that have recently been developed (e.g., Dunn, Singer, & Gould, unpublished study cited in Dunn, in press; Meyer, unpublished study cited in Meyer 1977; Spiro, Note 1; Spiro & Tirre, 1979). Although few in number, these latter cognitive-style experiments indicate, as did the earlier word-list studies, that people identified as having differing personality and cognitive styles do not encode and/or recall text in the same manner. Consequently, I now hold the strong belief that the systematic study of individual differences in processing or cognitive style is one of several necessary prerequisites before any truly predictive model of reading comprehension or discourse processing can be developed.

The remainder of my talk today will focus on two somewhat disparate studies, recently conducted in association with our laboratory, that hopefully will become part of the sparse data base currently available concerning cognitive and personality style differences in text processing - a data base which, again, I believe needs to be considerably strengthened before adequate models of text processing can be developed.

The first study investigated a "new" cognitive-style dimension that identifies people as analytic or holistic processors based on the amount of alpha activity (a bandwidth of electrical activity at 8-13Hz) measured from the cerebral cortex of the brain. Evidence will be presented that suggests these two styles recall different information from text. The second study was recently conducted by Bill Howell (1979) for his doctoral dissertation.

Bill compared the text recall of "normal" subjects with that of hospitalized acute schizophrenics and other hospitalized patients in order to investigate the possibility that schizophrenics use different processing strategies than do "normals". Bill's data suggest, at least at recall, that different strategies may be used by schizophrenics. Although based on different populations and research questions, both these studies have one thing in common, i.e., both show that classes of subjects dichotomized on cognitive style or personality variables, tend to recall different information from text, as measured by the new text analysis procedures (e.g., Meyer, 1975).

Bimodal Study

The first study was suggested by a growing body of research which indicates that variations in the electrical activity measured from the brain, particularly the amount of alpha activity, can be used to identify people having different cognitive styles. For example, differences in alpha activity have been found among occupational groups assumed to have different processing styles based on the nature of their professions (e.g., Davidson & Schwartz, 1977; Doktor & Bloom, 1977; Ornstein & Galin, 1966, 1976).

Much of this research has been influenced, at least to some degree, by what has been termed the bimodal theory of cognitive processing (Deikman, 1971, 1976; Dunn, in press; Ornstein, 1973, 1977). Bimodal theory, which should be viewed more as a set of organizing ideas than a fully developed theory, argues that the representation of information contained in long-term memory is influenced by the mode of conscious processing, analytic or holistic, used in encoding the information. The analytic mode is predominantly logical and sequential in its processing, while the holistic mode processes information in an intuitive and simultaneous or parallel manner. Similar notions

have been expressed by Paivio (1971, 1975) in describing his "dual coding" theory of memory.

Many investigators (e.g., Galin, 1974; Levy-Agresti & Sperry, 1968; Ornstein, 1973, 1977; Patterson & Bradshaw, 1975) have argued that bimodal processing is hemispheric dependent, with the left cerebral hemisphere of the brain being specialized for analytic processing and the right being specialized for holistic processing. Other evidence, however, (e.g., Cohen, 1975; White & White, 1975) indicates that both hemispheres may possess some analytic and holistic capability (see Dunn, in press, for an extensive review). Thus analytic and holistic processing styles might best be viewed as unique products caused by different "mixtures" or interactions of the cerebral hemispheres, rather than as separate functions of each.

Because of the growing controversy concerning the roles of the two cerebral hemispheres in cognitive processing (see Dunn, in press) our research has taken an approach that is not dependent of hemispheric differences in alpha activity, although they are measured. Rather than differentiating styles based on some ratio of right to left hemisphere alpha, where I might add there have been some recent and notable failures to demonstrate consistent differential hemispheric activation (e.g., Arndt & Berger, 1978), our index identifies cognitive style based on differences in the amount of bilateral alpha activity (both hemispheres summed) measured across people.

The bilateral alpha score which we use to differentiate styles was suggested by Deikman (1971, 1976) whose bimodal model proposes that when a person uses the analytic mode of processing, his or her EEG is characterized by an abundance of beta activity (greater than 13 Hz). In contrast, when that person utilizes the holistic mode of processing, the electrical brain activity consists largely of alpha waves (8-13 Hz). Deikman, like many

bimodal theorists (e.g., Ornstein, 1977) believes (1) that people have two modes of processing, the analytical and holistic, that differ more qualitatively than quantitatively, (2) that they use both modes in processing information and (3) that shifts in the balance of the two modes are quite common. We reasoned that if Deikman is correct, and people have two or more modes, then it is possible that individual differences in the balance of these modes may exist across individuals.

Even if Deikman (1971, 1976), numerous psychologists (Cohen, 1975; Patterson & Bradshaw, 1975; Ornstein, 1973, 1977; Paivio, 1971, 1975; White & White, 1975) and neurophysiologists (e.g., Levy-Agresti & Sperry, 1968; Levy & Trevarthen, 1976) are incorrect, and what really exists is merely a continuum of analytical processing as Pylyshyn (1973) and others apparently believe, it is still possible that the amount of alpha typically produced by subjects is inversely related to the amount of analytic processing used for various tasks. That is, high alpha production could be indicative of people who typically (not exclusively) give a smaller weighting to analytic processing, whereas low alpha production could be used to identify those people who possess a highly analytic style. In either case, I will present some research which, at the very least, clearly indicates that the amount of recorded alpha activity can be used to identify people who are more analytic than others.

Up to this point we have not collected enough data using holistic type tasks (e.g., the Street Gestalt Completion Test, Street, 1931) to be completely convinced that a largely holistic cognitive style exists. Thus, for the remainder of my talk I will use the terms high analytic and low analytic for what has previously been termed analytic and holistic processing styles.

The study I will now report (Dunn, Singer, & Gould, cited in Dunn, in press) was one of a series in which behavioral as well as physiological data were collected. The specific purpose of this study was to investigate whether individual differences in analytic (modal) cognitive style would affect the amount and the logical pattern of semantic information recalled from expository text. Expository text was used since it is generally more semantically complex than narrative discourse, consequently requiring increased analytic processing. Such text, then, should maximize the differences in processing (as inferred from free recall) of those persons identified as having a highly analytic, versus a less analytic (perhaps holistic) cognitive style.

Design and Procedure

Bilateral EEG measurements were taken from 40 upper division university students during a baseline period and during subsequent reading and recall tasks. The recordings were made from two parietal-temporal (P/T) sites; i.e., from a point midway between P_3 and T_3 on the left hemisphere, and midway between P_4 and T_4 on the right, in accordance with the 10-20 Electrode System (Jasper, 1958). Both sites were referred to Cz, which was chosen because it has been commonly used by past researchers interested in EEG correlates of cognitive processing (e.g., Doyle, Ornstein & Galin, 1974). This allowed us to compare our results against an existing body of research. Power in the alpha bandwidth (determined by Fourier analysis) was used as the brain-activity correlate in this experiment.

Immediately after an eyes-open baseline was taken, half the subjects, randomly chosen, was instructed to be alert and to concentrate as much as possible during the reading and recall tasks which followed. The other half was instructed to remain as relaxed as possible. The reason subjects received different learning and recall instructions was based on the findings of our

previous word-list research (Hymes, Dunn, Gould, & Harris, cited in Dunn, in press). This pilot study indicated that the amount of logical, categorical organization produced by high vs. low analytics was differentially affected by whether they were asked to be alert or relaxed during the learning and free recall of the word-list they were given. The recall protocols of high analytics contained significantly more categorical (logical) organization when they were asked to be alert than when asked to be relaxed during learning and recall, whereas an opposite pattern occurred with the low analytics who clustered slightly more when given "relax" instructions than "alert" instructions.[1]

Each subject was given three passages to read, with a written recall following the presentation of each passage (again, physiological recordings were taken during this period). The passages varied in terms of the amount of semantic and logical organization each contained, ranging from a loosely structured and slightly ambiguous text, to a highly organized, logically coherent passage. The passages, without their content structures, are shown in Table 1.

Insert Table 1 About Here

After all experimental data were collected, subjects' tape recorded EEG data were analyzed off-line using a Fourier analysis computer. Low analytic (holistic) subjects were defined as those whose summed, bilateral alpha power scores fell above the median, whereas high analytics were defined as those whose scores fell below it.

Results

One of the major advantages of the new text grammars (e.g., Kintsch, 1974; Meyer, 1975) is that they can identify the pattern of subordination (hierarchy)

of the semantic information contained in text regardless of where it physically occurs in the passage. This allows the recall protocols produced by high analytic and low analytic (holistic) processors to be compared against a common metric (the obtained hierarchical pattern), which identifies the most logically important and least important material contained in text. Meyer's (1975) grammar has the added advantage of naming the implicit and explicit relationships existing within, and between, the levels of the semantic hierarchy. Meyer describes several types of relationships: 1) Lexical predicates (typically verbs) which are actual explicit relationships stated in text; 2) Rhetorical predicates which are implicit relationships primarily (although not exclusively) used to describe a text's superordinate or macrostructure; and 3) Role relations, also implicit, which are typically used to describe the intrasentence or subordinate levels of text.

For illustration, Table 2 shows one of the passages used in the second experiment I will report today. Figure 1, immediately following, is the content-structure analysis of that passage analyzed by Meyer using her content-structure grammar. (This passage and its analysis are from Meyer & Freedle, 1979.)

Insert Table 2 and Figure 1 About Here

Note that the items on the far left of the hierarchy are assumed to be the most semantically or logically important items in the text, whereas those on the far right are deemed the least important. Of major interest here is the recall data scored using Meyer's text analysis.

Rather than report the results in detail, I will quickly summarize and speculate about the more interesting findings, most of which centered around

the proportional recall data. Proportions were required because the analyses of the semantic content of the passages using Meyer's (1975) grammar resulted in content or semantic structures that contained differing numbers of idea units at each level of the obtained hierarchy. Therefore, the number of idea units (propositions and their related predicates and arguments) recalled by each subject at each level of subordination in a given passage's content-structure was converted to the proportion of the total number of units possible at each level of that (semantic) content structure.

Tables 3 and 4 show the mean proportional recall as a function of type of processor, instructions and levels in the semantic content structure. Note that these results are from passages that varied in the amount of semantic structure each contained from the loosely structured sea-floor passage on the bottom of Table 3 to the highly structured breeder reactor passage shown in Table 4.

Insert Tables 3 and 4 About Here

The data suggest that when the text has little semantic organization (data from the sea-floor passage bottom of Table 3) the proportional recall of high analytics and low analytics was basically the same when compared at each level of subordination of the semantic content structure of the passage. However, as the amount of text organization increased (see data at the top of Table 3 and data of Table 4) high analytics, particularly when they were asked to concentrate during the learning and recall task, recalled proportionally more of the superordinate Level 1 items than items at lower levels. In contrast, the low analytics, when instructed to concentrate, did not recall as much high-level information. If anything their best recall of superordinate

information occurred when they were asked to relax rather than to concentrate during the experimental task. [This interpretation was confirmed by mixed analyses of variance with unequal cell sizes and appropriate simple effects tests (See Dunn, in press). It should be noted that the important three-way, type of processor by instructions by levels interaction was marginally significant with the asteroid recall data ($p<.07$). However, it was highly significant ($p<.003$) when the data from the tightly structured breeder reactor passage was analyzed.]

These results generally replicate those of our previous word-list study (Hymes et al, 1977) which showed that high analytics produce significantly more clustering at recall when they were asked to concentrate and less clustering when they were asked to relax, whereas just the opposite pattern with the low analytics whose best performance occurred when they were given relaxation instructions.

The prose recall results indicate that analytics tend to recall more superordinate information than less analytically inclined students, and that the recall patterns of both types of processors are differentially affected by the learning and recall instructions they are given. This latter finding argues against a simple arousal explanation of the data, and suggests that two distinct cognitive styles have been identified.[2]

As further support for this view, a brief scan of the mean alpha data shown in Table 5 clearly shows that high analytic and low analytic subjects maintained their relative difference in recorded alpha even during the reading and recall tasks they were given. This "between subjects"

Insert Table 5 About Here

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consistency does not appear to be temporary either. Subjects have been found to maintain their relative positions (using the same recording sites as above) over two sessions containing both verbal and spatial tasks, with at least two weeks separating the two sessions (Dunn, Kinslow, Hymes, Gould, & Harris, Note 3; Erlichman & Wiener, 1979). These results strongly suggest that power in the alpha band is a highly reliable correlate of bimodal processing style.

Taken together we believe that our results have provided empirical support for the notion of a "bimodal" cognitive-style dimension. Although considerably more research is needed to determine whether this dimension is more qualitative than quantitative (i.e., analytic vs. holistic) or is primarily quantitative in nature (i.e., high vs. low analytic), these results suggest, as does the work of Spiro (Spiro, Note 1; Spiro & Tierre, 1979), that prose recall and perhaps even encoding may be strongly affected by one's preferred cognitive-processing style.

Schizophrenic Recall Study

Further evidence in support of this point comes from the results of Bill Howell's (1979) study which compared the expository prose recall of "normal" college students, schizophrenics, and other hospitalized mental patients. Based on a pre-experimental interview and testing session, as well as hospital records in the case of the hospitalized patients, Howell carefully equated his three all-male groups on age, education, and verbal intelligence.

Following the work of Meyer & Freedle (1979), four experimental passages were developed from two topics. The first topic, borrowed from Meyer and Freedle, was concerned with the loss of water from the human body. The second topic dealt with the use of chemical pesticides. Two versions of each topical passage were constructed, with one version having a top-level semantic structure consisting of a covariance or cause-and-effect relation, and the other

version having an attribution top-level semantic structure that consisted of a mere listing of facts concerning the topic. An example of the covariance version of the loss of body water passage again can be found in Table 2 of your handout, and the content structure of that version can be found in Figure 1.

Each subject received both topical passages and both top-level semantic structures to read and free recall. However, in order to prevent any transfer effects, each subject was given only one top-level structure for each topic, thus yielding a nested design.

Because of the numerous analyses that Howell performed on his data, I will briefly summarize those findings and conclusions of particular relevance here. Basically, when Howell analyzed his proportional recall data, he found a significant three-way group by top-level structure (attribution/covariance) by levels in the content structure interaction, even when reading time and reading ability were statistically controlled. This interaction (and related simple effects tests) clearly indicated that schizophrenics recalled proportionally less semantic information at different subordinate levels of the attribution versions (Level 3) compared to the covariance versions (Level 4) of the passages than did either the hospitalized non-schizophrenics or "normal" college students. Remarkably, these latter two groups (college students and non-schizophrenics) actually recalled proportionally more items from those subordinate levels than they did at the more superordinate levels 1 & 2 of both content-structures. This latter finding is contrary to much of published research in the area (e.g., Kintsch, et al., 1975; Meyer, 1975), but is similar to the recent findings of others (e.g., Dunn, Mathews, & Bieger, 1979).

Examination of the content structures of both versions of the passages showed that much of the information contained at those lower levels was information described by a collection rhetorical predicate (using Meyer's 1975 grammar), where a collection rhetorical predicate describes a list of elements that are related in some unspecified manner in text (for example the level 3 items contained on lines 11-16 of Figure 1: wrestlers, boxers, judo contestants, karate contestants, 150 pound football team members). Subsequent analyses of the recall protocols for the three groups indicated that the schizophrenics rarely recalled any of the text information described by the collection relation, whereas both the undergraduates and non-schizophrenic mental patients recalled much of this information which was embedded within the lower levels of the content structures of the two versions (attribution and covariance) of the passages. The almost total lack of recall of collection-type information at any level from text was interpreted by Howell to suggest the existence of different semantic processing strategies between the schizophrenics and the other two groups.

Summary and Conclusions

In conclusion, the results of all the studies that I have discussed are at variance with a large body of current prose memory research which, because that research has ignored cognitive style and personality differences, has produced results showing that the "typical" reader recalls more of the semantically important than semantically less important information from text. These results have led many investigators to assume that subjects form hierarchically organized memory structures while reading text, and that they use these memory structures as a basis for retrieval (e.g., Kintsch et al., 1975; Meyer, 1975; Meyer & McConkie, 1973).

Perhaps that is the case - but I doubt things are so simple. For example, Howell's (1979) data suggest that normal and hospitalized non-schizophrenic adults actually recall more information from the subordinate levels text than from the superordinate levels when that subordinate information consists of unspecified categorical information. (Similar observations have been found with children, e.g., Dunn, Mathews, & Bieger, 1979.) Schizophrenics, even when they were equated on age, schooling, verbal I.Q., and reading ability (using traditional measures) rarely recalled any unspecified categorical information. The results of our bimodal-processing study indicate that individuals differing in analytic processing style, differentially recall superordinate and subordinate semantic information from text as a function of learning and recall instructions (Dunn, Singer, & Gould, cited in Dunn, in press). Since the population used in this study consisted solely of upper-division college students, it is hard to believe that they were very disparate in reading ability. Finally, Spiro & Tierre's study, which as you will recall also equated subjects on verbal I.Q., suggests that the recall of certain types of semantic information from narratives may be related to the cognitive style of field dependency. In short, few of the subjects in these three studies acted in ways predicted by the "universal" theories of memory that are currently in vogue (e.g., Stage Theory - Atkinson & Shiffrin, 1968; levels of processing theory - Craik & Lockhart, 1972; and the highly popular schema theory - Norman & Rumelhart, 1977).[3]

Since human beings are a rather homogenious species, and hence tend to perceive and process information in similar ways, one can understand and agree, in part, with the search for a "universal" theory of learning and memory for textual as well as other types of information. However, assuming as I do, that there is also considerable variation across the human species in

modes of cognitive processing, the argument can be made that our current theories, which only describe "universal" processes, may be too abstract, too over generalized, and thus too simplified to have predictive power in a large portion of individual cases. Unless major classes of individual differences are identified and taken into account, I believe our theories will continue to have limited applicability to "real" educational problems such as reading instruction and remediation. Quite frankly, I am of the opinion that much of our psychological and educational theorizing concerning text comprehension is premature primarily because it is founded on a rather restricted data base.

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Footnotes

[1]The attentive reader/listener may think that the cognitive style construct identified here, i.e., high and low analytic or perhaps analytic vs. holistic, is highly similar or identical to the constructs of field independence/dependence (Witkin et al., 1962) or locus of control (Rotter, 1966). Based on a recently completed Master's thesis conducted in our laboratory (Hunt, 1979) scores on locus of control and field dependency did not correlate significantly with the alpha measurements used to identify high and low analytic styles. Nor did a multiple regression analysis show that field independence/dependence or locus of control scores were significant predictors of the alpha scores used to identify our styles. Thus as this point, we believe that if a relationship exists among these constructs and ours, it is weak at best.

[2]The old notion that alpha is correlate of simple arousal and follows the traditional inverted "U" shape function was seriously questioned in a clever set of experiments reported by Wilson and Orne (1977) who showed that, among other things, subjects can show high alpha even under conditions of high arousal. The interested reader will find many other arguments against the simple arousal notion in the article as well as evidence for systematic individual differences in alpha production.

[3]Norman and Rumelhart (1977) do play lip-service to individual differences in their influential version of schema theory by stating that various individuals can have different schema concerning the same topic. Unfortunately they do not explain whether these different schema merely contain different material, whether they contain different rules or strategies for processing new information, or whether they contain both.

Table 1

Experimental Passages Used in Bimodal Study
(Dunn, Singer, & Gould, cited in Dunn, in press)

Passage with the Least Semantic and/or Logical Structure
(From Kintsch et al., 1975)

New sea floor and mantle are currently being added to the crust of the earth at spreading centers under deep-sea ridges. The sea floor spreads laterally away from these centers and sinks into the interior of the earth in deep-sea trenches. Volcanoes are created by the consumption process and flank the trenches. Thus, the volcanoes mark the borders between the plates which comprise the shell of the earth.

Passage with More Structure
(From Kintsch et al., 1975)

Asteroids are miniature planets that orbit around the sun. Hundreds of asteroids have been identified, but it is difficult to keep track of them, since all asteroids are alike. An asteroid is identified only by the position of its orbit. Even after an orbit has been determined, it is often lost because the orbit changes due to the influence of the large planets which deflect the asteroid from its orbit.

Passage with the Most Semantic Structure
(Modified from Meyer, 1975)

The need to generate enormous additional amounts of electric power while at the same time protecting the environment is taking form as one of the major social and technological problems that our society must resolve over the next few decades. The Federal Power Commission has estimated that during the next 30 years the American power industry will have to add some 1,600 million kilowatts of electric generating capacity to the present capacity of 300 million kilowatts. As for the environment, the extent of public concern over improving the quality of air, water, and landscape hardly needs elaboration.

A related problem of equal magnitude is the rational utilization of the nation's finite reserves of coal, oil and gas. In the long term they will be far more precious as sources of organic molecules than as sources of heat. Moreover, any reduction in the consumption of organic fuels brings about a proportional reduction in air pollution from their combustion products.

The breeder type of nuclear reactors holds great promise as the solution to these problems. Breeder reactors produce more nuclear fuel than they consume; they would make it feasible to utilize enormous quantities of low-grade uranium and thorium ores dispersed in the rocks of the earth as a source of low-cost energy for thousands of years. In addition, these reactors would operate without adding noxious combustion products to the air.

Table 2

Passage Used in Schizophrenic Recall Study

Covariance Version of the Loss of Body Water Passage

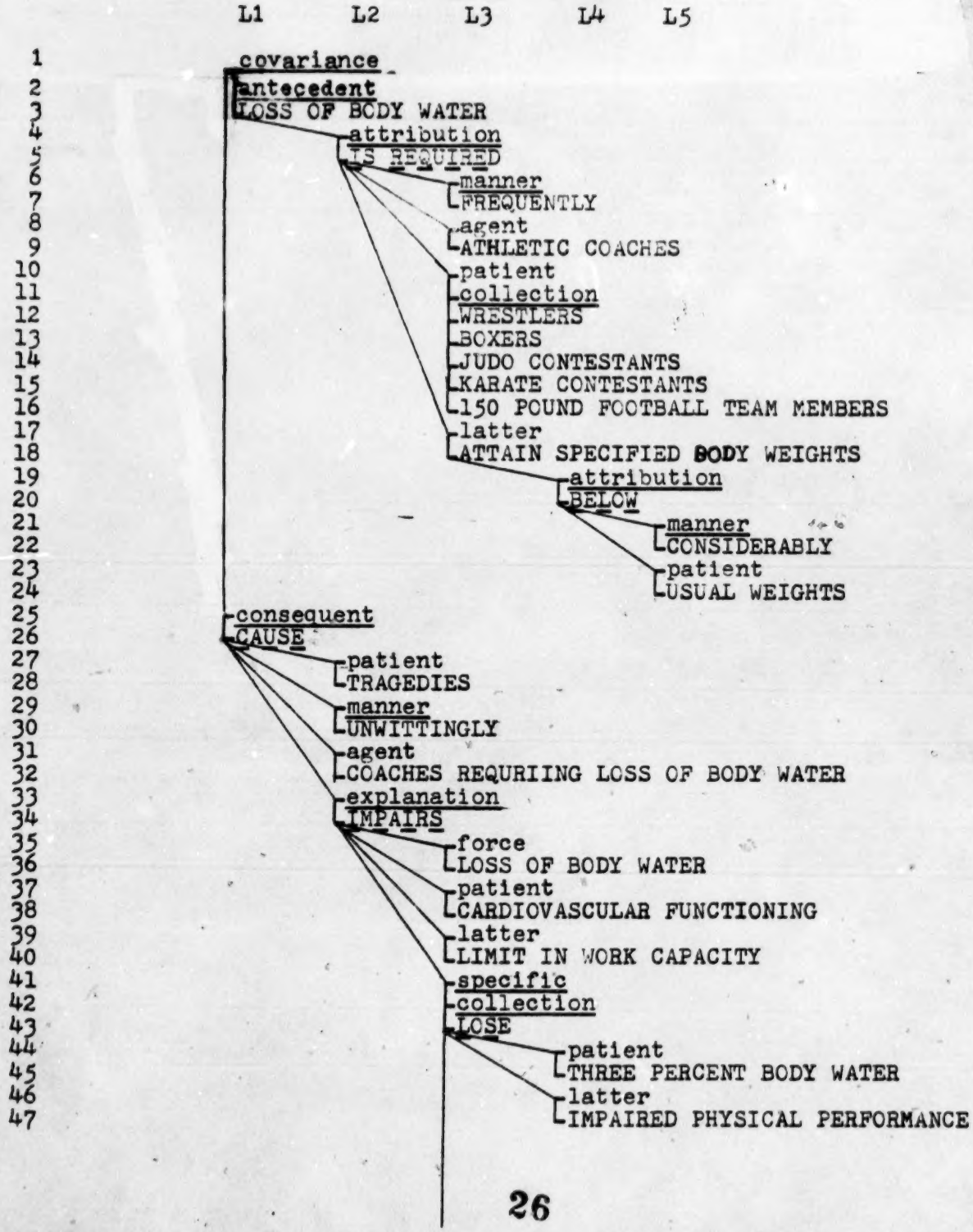
It is true that the loss of body water is frequently required by athletic coaches of wrestlers, boxers, judo contestants, karate contestants, and 150 pound football team members so that they will attain specified body weights. These specified weights are considerably below the athletes' usual weights.

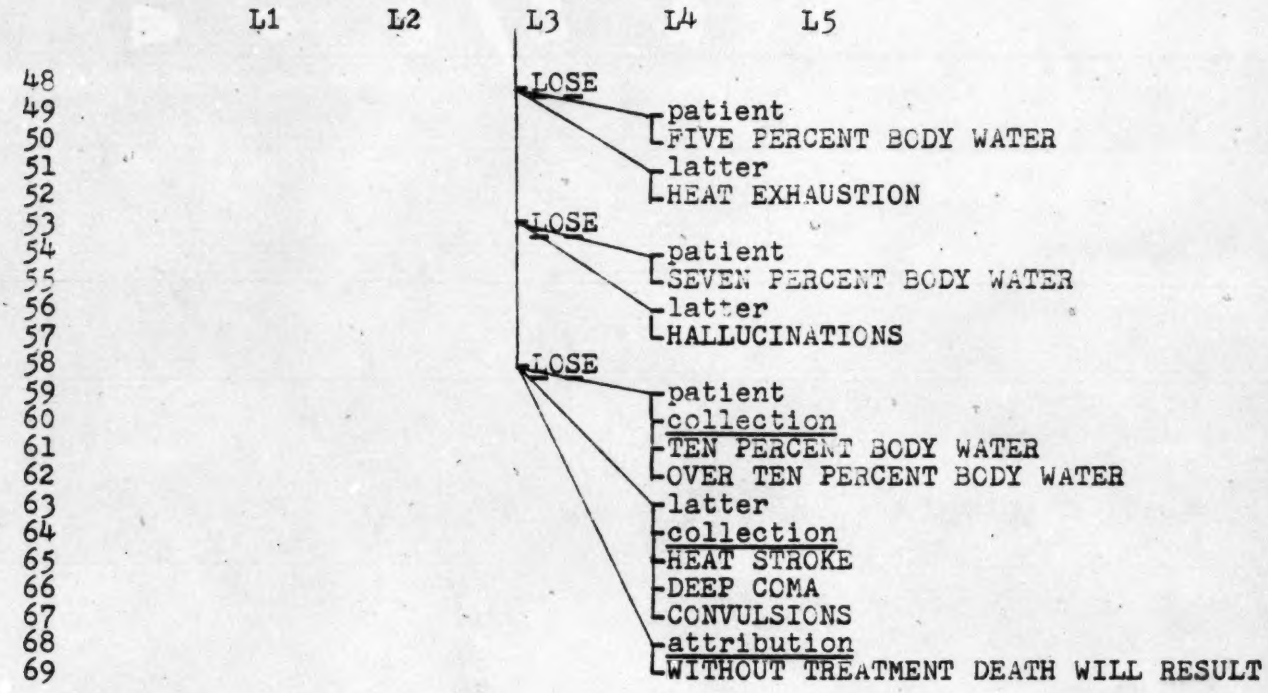
As a result, tragedies are unwittingly caused by coaches requiring this loss of body weight in these situations. These tragedies occur due to the fact that the loss of body water impairs cardiovascular functioning limiting work capacity. More specifically, a loss of three percent of body water impairs physical performance and a loss of five percent results in hear exhaustion. Moreover, a loss of seven percent of body water causes hallucinations. Losses of ten percent or more of body water result in heat stroke, deep coma, and convulsions; if not treated death will result.

Figure 1

Passage Used in Schizophrenic Recall Study

The Content Structure of the Covariance Version of the Loss of Body Water Passage (Modified from Meyer & Freedle, 1979)





Key

Capitalized words= Content words from text

Capitalized words with dashed lines under them= Words from text serving as Lexical Predicates

Lower case words= Role Relations

Underlined, lower case words= Rhetorical Predicates

Table 3

Mean Proportional Semantic Recall for the Two "Short" Passage as a Function of Type of Processor, Instructions, and Levels in the Semantic Content-Structure Using Meyer's Scoring Procedure

Type of Processor	n	*Levels in Content-Structure 1	2	3	4	5
"More" Structured "Asteroid" Passage (From Kintsch et al., 1975)						
High Analyticals						
Concentration instructions	9	1.00	.58	.34	.31	.00
Relaxation instructions	11	.82	.47	.25	.30	.00
Low Analyticals (Holistic)						
Concentration instructions	11	.72	.50	.24	.19	.00
Relaxation instructions	9	.89	.36	.28	.18	.11
"Least" Structured "Sea Floor" Passage (From Kintsch et al., 1975)						
High Analyticals						
Concentration instructions	9	.33	.48	.30	.17	.00
Relaxation instructions	11	.39	.33	.17	.10	.09
Low Analyticals (Holistic)						
Concentration instructions	11	.41	.48	.26	.20	.04
Relaxation instructions	9	.37	.44	.09	.15	.00

*Levels in Content-Structure Was a Repeated Measure

Table 4

Mean Proportional Semantic Recall of "Tightly" Structured Breeder Reactor Passage as a Function of Type of Processor, Instructions and Levels in the Context-Structure, Scored Using Meyer's (1975) Procedure

Type of Processor	n	Levels in Content-Structure 1	2	3	4
High Analyticals					
Concentration instructions	9	.67	.28	.24	.17
Relaxation instructions	11	.52	.29	.22	.23
Low Analyticals (Holistics)					
Concentration instructions	11	.39	.33	.24	.23
Relaxation instructions	9	.49	.20	.08	.09

Table 5

Mean Alpha Power Recorded During Reading and Recall, as a Function of Type of Processor, Hemisphere and Passage

Type of Processor	Passage		
	Asteroid	Sea-Floor	Breeder Reactor
Reading Alpha Data			
High Analyticals			
Left hemisphere	1.96	1.71	.73
Right hemisphere	1.59	1.12	.46
Low Analyticals (Holistic)			
Left hemisphere	4.29	3.90	1.98
Right hemisphere	3.79	3.18	1.45
Recall Alpha Data			
High Analyticals			
Left hemisphere	1.11	.79	.79
Right hemisphere	.77	.50	.39
Low Analyticals (Holistic)			
Left hemisphere	1.74	1.47	1.07
Right hemisphere	1.39	.96	.76